

Remarks

Objections to the Specification

The following amendments have been made to the specification as required by the Examiner. The ABSTRACT OF THE DISCLOSURE has been amended to avoid the use of the word “means.” The Abstract now identifies electric resistance heating as an illustration of heating means for repairing or tuning the shape memory material. This mode of heating the deformable members is disclosed in paragraph 0012 of the specification, Paragraph 0018 of the specification has been amended to change “mean” to “means.” Accordingly, it is respectfully requested that these objections be removed.

Objection to the drawings

The Examiner has objected to the drawings for failing to include reference numeral 38 used in paragraph 0021. Paragraph 0021 has been amended to delete its usage of numeral 38. The connector for the front end 34 of coil spring 32 to the backside of front 24 of crash box 14 is not visible in the final version of Figure 2. But a connector like connector 40 for the rear end 36 of the spring to base plate 30 may be used. Accordingly, it is respectfully requested that the objection to the drawings be removed.

Amendments to the Claims

Independent claims 1, 11, and 14 are amended to more clearly state the invention. As disclosed in the title and the specification of this application, this invention includes a vehicular impact absorbing device that is both tunable in energy absorbing capacity before impact and healable after relatively low energy impacts. These independent claims recite that each of the deformable energy absorbing members has two strength levels. Each deformable member has a first strength level at an operating temperature of the device and a second strength level at a higher temperature. And each of the deformable members is selectively (individually) heatable from the operating temperature to the higher temperature to tune or adjust the energy absorbing capacity of the device (paragraph 0028). Claims 11 and 14 require additionally that the device comprise electrical connections to each of the deformable members for selectively heating them by electrical resistance heating. With the crash sensing capabilities of modern vehicles such

tuning can be accomplished even at the onset of a crash incident. Paragraphs 0009-0013, and 0027-0036 of the specification disclose the tunable features of the device recited in these claims.

Claim 3, which is dependent on claim 1, additionally states that the absorption of the impact energy is accomplished by stretching of the deformable members. This feature is illustrated in the embodiment of Figure 2 and of Figure 3 (unrolling and stretching) and corresponding text. Dependent claim 5 recites that a deformable member(s) of the device is formed of shape memory alloys comprising titanium and nickel. In this embodiment the deformable member(s) has a relatively low strength martensite phase at the operating temperature and a higher strength austenite phase at a higher temperature (see paragraphs 0009 and 0028).

Claim 12, which is dependent on claim 11, and claim 15, dependent on claim 14, also recite the use of a shape memory alloys which are strengthened by heating.

Dependent claims 4, 6, and 16-18 have been amended to require that at least one deformable member be of the respective material or configuration specified.

Dependent claim 19, referring to claim 1, and dependent claim 20, referring to claim 14, are newly added to the application. These dependent claims require at least one of the deformable members in the claimed device be of a shape memory polymer. And each such deformable member has a relatively high strength at the operating temperature of the device and a lower strength at the higher temperature. These features of the invention are disclosed in paragraph 0035 of the specification.

The Rejections of Claims

Claims 1, 2, 4, 5, 11 and 13 are rejected under 35 U.S.C. 102(e) as being anticipated by Julien, U.S. Patent 6,530,564. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Julien.

Claims 3, 6, and 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isaacson, U.S. Patent 3,788,626 in view of Julien and Kim, U.S. Patent 6,050,624.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Julien in view of Ikematu et al, U.S. Patent 5,189,110.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over the references as applied above to claim 14 and further in view of Ikematu et al.

It is respectfully requested that each of these claim rejections be reconsidered and removed for the following reasons.

The Pending Claims

Claims 1-6 and 11-19 are presently under consideration. Each claim recites a device for absorption of impact energy for use on a vehicle body component. The device comprises one or more deformable members of shape memory material aligned for deformation by an impact. Each deformable member is formed of a material that has two different strength levels- one level at the operating temperature of the device, usually an ambient temperature, and a different strength level at a higher temperature. Each deformable member is selectively heatable so that its strength level can be individually controlled by heating it (or not heating it). Each deformable member of such a device can have a pre-tuned initial strength level for energy absorption. Vehicle speed or deceleration (paragraph 0032) can be sensed and used in further tuning the strength of each deformable member before or at a sensed onset of collision. Independent claims 1, 11, and 14 recite these unique features of the invention and the dependent claims recite additional embodiments.

Neither, the Julien '564 patent nor its combination with Isaacson '626, Kim '624, and/or Ikematu et al '110 teach or suggest the energy absorbing devices recited in claims 1-6, and 11-18.

The References

The Julien '564 patent describes the use of Nitinol® impact absorbers. These materials are nickel-titanium alloy shape memory materials. The Examiner refers to Figures 19 and 20 and the related text in columns 7 and 8. Opposite ends of Nitinol® rods 162 are attached respectively to bumper 164 and frame 166 of a vehicle. The rods are preformed in zigzag or sinusoidal pattern to deflect under an impact on the bumper. The rods are made to remain in the martensite state in vehicle use and to be heated above the martensite/austenite phase

transformation temperature to restore their original shape after an impact deforms them. The shape memory rods absorb energy by bending or compression of the initial forms.

The Julien patent discloses no concept of an energy absorption device in which one or more deformable of shape memory material are arranged for selective heating to alter the strength of the member as a way of tuning or changing the energy absorption capacity of the device on a vehicle. Julien contemplates the use of two different types of Nitinol® energy absorbing wires or rods: a high transition temperature type used in the Martensite state and a low transition temperature type used in the Austenite state (called “superelastic”). While deformation members of these different types can be mixed, there is absolutely no disclosure in Julien of a device in which individual members are arranged or adapted to be selectively heated to alter the energy absorption capacity of the device after initial assembly.

Certainly there is no teaching or suggestion in Julien that would anticipate [102 (e)] or render obvious section [103(a)] the content of any of claims 1, 2, 4, 5, or 11-13. It is respectfully urged that the rejection of these claims as unpatentable over the Julien patent must be removed.

The Isaacson ‘626 patent and Kim ‘624 patent disclose the use of crash boxes as energy absorption devices for vehicles. But neither of them, even when combined with Julien, teach or suggest a crash box with selectively heatable deformation members for tuning the energy absorption capacity of the device. It is respectfully requested that the rejection of claims 3, 6, and 14-16 be reconsidered and removed.

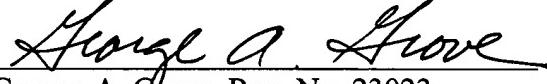
The rejections of claims 17 and 18 must also be reconsidered and removed. While Ikematu et al disclose the use of shape memory polymers in automobile bumpers, the teaching does not compensate for the above summarized deficiencies in Julien, Isaacson or Kim in teaching or suggesting the inventions recited in these dependent claims. And the combination of references does not teach or suggest a device using a selectively heatable deformable member of a shape memory polymer that can be tuned by heating it to soften it. Claims 19 and 20 are clearly patentable over such references.

In summary and for the specific reasons stated, the various combinations of the four patents applied by the Examiner in rejecting Applicants' claims fail to render unpatentable the inventions of any of claims 1-6 and 11-20 as now presented.

Conclusion

It is respectfully requested that the rejections of claims 1-6 and 11-18 be reconsidered and that these claims be allowed. In view of the patentability of generic claim 1 it is also urged that withdrawn dependent claims 7-10 be reconsidered in this case, and allowed. Thus, the issuance of a patent with claims 1-20 is respectfully urged.

Respectfully Submitted,


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